WHAT IS CLAIMED IS:

1. A point-to-multipoint optical communications system comprising:

   an optical line terminal (OLT); and

   a plurality of optical network units (ONUs) connected to said OLT by a passive optical network in which downstream data is transmitted from said OLT to said ONUs over said passive optical network and upstream data is transmitted from said ONUs to said OLT over said passive optical network;

   said OLT transmitting downstream data over said passive optical network in variable-length downstream packets;

   said ONUs transmitting upstream data over said passive optical network within ONU-specific time slots utilizing time division multiplexing, wherein said ONU-specific time slots are filled with multiple variable-length upstream packets.

2. The system of claim 1 wherein said variable-length downstream packets are formatted according to IEEE 802.3.

3. The system of claim 1 wherein said variable-length downstream packets include Internet protocol (IP) datagrams.

4. The system of claim 3 wherein the lengths of said variable-length downstream packets are related to the lengths of said IP datagrams.

5. The system of claim 1 wherein said variable-length upstream packets are formatted according to IEEE 802.3.

6. The system of claim 1 wherein said variable-length upstream packets include Internet protocol (IP) datagrams.

7. The system of claim 6 wherein the lengths of said variable-length upstream packets are related to the lengths of said IP datagrams.

8. The system of claim 1 wherein:

said variable-length downstream packets and said variable-length upstream packets are formatted according to IEEE 802.3; and

said downstream data and said upstream data include Internet protocol (IP) datagrams.

9. The system of claim 1 wherein:

said OLT includes a fragment buffer for storing packet fragments that have been transmitted upstream from said ONUs; and

said ONUs include fragment buffers for storing packet fragments that are to be transmitted upstream from said ONUs.

10. The system of claim 9 wherein said ONUs include fragment logic for:

splitting a variable-length upstream packet into first and second packet fragments; and

adding an end-of-packet-fragment code to said first packet fragment and adding a start-of-packet-fragment code to said second packet fragment.

11. The system of claim 10 wherein said OLT includes fragment logic for:

identifying said end-of-packet-fragment code of said first packet fragment;

buffering said first packet fragment in said OLT fragment buffer;

identifying said start-of-packet-fragment code of said second packet fragment; and

reconstructing said variable-length upstream packet from said first and second packet fragments.

SUB A3

12. A method for exchanging information between an optical line terminal (OLT) and multiple optical network units (ONUs) in a point-to-multipoint passive optical network comprising:

transmitting downstream data from said OLT to said ONUs in variable-length downstream packets;

transmitting upstream data from said ONUs to said OLT in ONU-specific time slots utilizing time division multiplexing to avoid transmission collisions, wherein said ONU-specific time slots are filled with variable-length upstream packets.

13. The method of claim 12 wherein said variable-length downstream and upstream packets are formatted in accordance with the IEEE 802.3 protocol.

SUB A4

14. The method of claim 12 wherein said variable-length downstream and upstream packets include a header and a payload, and wherein the length of each of said variable-length packets is related to the length of an Internet protocol (IP) datagram that is included in the payload of said variable-length packets.

15. The method of claim 12 further including steps of:

inserting downstream Internet protocol (IP) datagrams into said variable-length downstream packets; and

inserting upstream IP datagrams into said variable-length upstream packets.

16. The method of claim 15 wherein said variable-length downstream and upstream packets are formatted in accordance with the IEEE 802.3 protocol.

17. The method of claim 12 wherein said step of transmitting downstream data includes transmitting downstream synchronization markers at constant time intervals.

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18. The method of claim 12 wherein said ONU-specific time slots are filled with multiple variable-length packets.

19. The method of claim 12 further including the steps of:

splitting a variable-length upstream packet into a first packet fragment and a second packet fragment;

adding an end-of-packet-fragment code to the end of said first packet fragment; and

adding a start-of-packet-fragment code to the start of said second packet fragment.

20. The method of claim 19 further including steps of:

transmitting said first packet fragment upstream in a first ONU-specific time slot;

buffering said second packet fragment for transmission in a second ONU-specific time slot that is different from said first ONU-specific time slot;

buffering said first packet fragment after said first packet fragment is received at said OLT; and

reconstructing said variable-length upstream packet, at said OLT, from said first packet fragment and said second packet fragment.

21. A point-to-multipoint optical communications system comprising:

an optical line terminal (OLT); and

a plurality of optical network units (ONUs) connected to said OLT by a passive optical network in which downstream data is transmitted from said OLT to said ONUs and upstream data is transmitted from said ONUs to said OLT;

said OLT including means for formatting downstream datagrams into variable-length downstream packets;

each of said ONUs including:

means for formatting upstream datagrams into variable-length upstream packets; and

means for timing the transmission of said variable-length upstream packets to coincide with ONU-specific time slots in order to avoid collisions with upstream packets from other ONUs.

22. The system of claim 21 wherein said variable-length downstream packets are formatted according to IEEE 802.3.

23. The system of claim 21 wherein said downstream datagrams are Internet protocol (IP) datagrams.

24. The system of claim 23 wherein the lengths of said variable-length downstream packets are related to the lengths of said IP datagrams.

25. The system of claim 21 wherein said variable-length upstream packets are formatted according to IEEE 802.3.

26. The system of claim 21 wherein said upstream datagrams are Internet protocol (IP) datagrams.

Sub A6

27. The system of claim 26 wherein the lengths of said variable-length upstream packets are related to the lengths of said IP datagrams.

Sub B1

28. The system of claim 21 wherein:

said variable-length downstream packets and said variable-length upstream packets are formatted according to IEEE 802.3; and

said downstream datagrams and said upstream datagrams are Internet protocol (IP) datagrams.

29. The system of claim 21 wherein:

said OLT includes a fragment buffer for storing packet fragments that have been transmitted upstream from said ONUs; and

said ONUs include fragment buffers for storing packet fragments that are to be transmitted upstream from said ONUs.

30. The system of claim 29 wherein said ONUs include fragment logic for:

splitting a variable-length upstream packet into first and second packet fragments; and

adding an end-of-packet-fragment code to said first packet fragment and adding a start-of-packet-fragment code to said second packet fragment.

31. The system of claim 30 wherein said OLT includes fragment logic for:

identifying said end-of-packet-fragment code of said first packet fragment;

buffering said first packet fragment in said OLT fragment buffer;

identifying said start-of-packet-fragment code of said second packet fragment; and

reconstructing said variable-length upstream packet from said first and second packet fragments.

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